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PATENT SPECIFICATION

NO DRAWINGS

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COMPLETE SPECIFICATION

The Centrifugal Casting of Rollers

We, COURTAULDS LIMITED, a British Company, of 18, Hanover Square, London, W.1., England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the centrifugal casting of cylindrical shells of polymeric material and particularly to the casting of such shells having a raised or indented design on their outer peripheral surfaces. The casting of such shells for use when mounted on shafts, as printing rollers, particularly for the gravure process, is described in our British Patent Specification No. 1,045,674.

One problem arising in the centrifugal casting process is the removal of the cast shell from the casting cylinder without damage to the outer surface of the shell. The methods used so far to overcome this problem have not been satisfactory for one reason or another. Thus the use of a casting cylinder which can be dismantled leads to casting inaccuracies. Again, the use in the casting cylinder of a rigid liner which can be removed with the shell and expanded by heat before separating it from the cast shell and the liner can lead to abrasion of the outer surface of the shell. This is particularly likely to happen when a raised or indented pattern is cast into the outer surface of the shell.

According to this invention, a process for centrifugally casting a cylindrical shell of a polymeric material comprises injecting into a casting cylinder a first charge of a liquid material capable of being formed into a solid polymer, forming the solid polymer in contact with the inner surface of the casting cylinder whilst the casting cylinder is rotated to form a cylindrical liner, injecting a second charge of a liquid material capable of being formed into a solid polymer into the casting cylinder and forming the solid polymer while the casting cylinder is rotated to form a cylindrical shell of polymeric material within the liner, removing the shell and the liner together from the casting cylinder and peeling the liner from the shell.

The advantage of the process of the invention arises from the fact that the liner is peeled from the shell rather than slid off it, and so the shell is not subject to any abrasive action which could cause imperfections in its outer surface. The obtaining of a perfect outer surface on the shell is particularly important if the shell is to be used as a printing roller.

If necessary, a release layer can be applied to the liner before the shell is cast so that the two do not adhere. For example the application of a release layer becomes necessary when the liner is cast for convenience from the same epoxy or polyester resin precursor as the shell. The desirable thickness of the liner is governed by several factors. Thus, the liner should be sufficiently strong to withstand removal from the casting cylinder without disintegrating, while being thin enough to be peelable from the cast shell. Also, from an economic point of view, the less material used to form the liner, the cheaper is the process. It is helpful if the liner material can softened to aid the peeling operation, for example polyester and epoxy resins may be plasticised by mild heating, say from the application of warm water.

When a shell bearing a raised or indented design on its outer peripheral surface is to be cast then the relief pattern which is to produce that design is formed on the inner surface of the liner before the shell is cast. The relief pattern may be a photographically-produced gelatin pattern as described in our British Patent Specification No. 1,045,674. As

[*Price 5s. 0d.*]

the formation of the gelatin relief pattern on the liner is most conveniently done outside the casting cylinder, it becomes necessary to remove the liner from the casting cylinder. However, a liner which is sufficiently thin to be easily peeled from the shell according to the process of the invention is not sufficiently robust to withstand the operations used for forming the gelatin relief pattern without being broken or permanently distorted, and so it is preferred that a comparatively thick, robust liner is centrifugally cast within the casting cylinder before the peelable liner is cast. The two liners can be removed from the casting cylinder together and the thicker liner acts as a support while the gelatin relief pattern is formed on the peelable liner. If necessary, for example when the two liners are, for convenience, cast in the same material, such as an epoxy resin, a release layer should be applied to the thicker liner before the peelable liner is cast so that the two liners can be separated at a later stage.

A gelatin relief pattern may be formed on the inner surface of the peelable liner according to the following procedure: A sheet of so-called carbon tissue, consisting in a stout paper support sheet coated with an intermediate layer of a black pigmented gelatin preparation and an outer layer of a transparent gelatin preparation is sensitised by immersing it in an aqueous solution of bichromate and dried. Such carbon tissues are well known in the printing industry. The sensitized tissue is then photographically exposed simultaneously through a transparency of the design and a cross-line screen, before being squeegeed, gelatin side down, onto the inner surface of the peelable liner by a rotating rubber-faced roller positioned within and with its axis parallel to the composite liners. The rubber-faced roller is opposed by a similar idling roller pressing against the outer surface of the thicker liner.

The squeegee process is well known in the printing and photographic industries and in essence comprises the pressing of a thin film or sheet into intimate contact with a wetted smooth surface by means of a sweeping action, for example by means of a roller, so that the liquid is swept from between the two contacting surfaces along with any air which could otherwise become trapped. After the tissue has been squeegeed on, the tissue is soaked in warm water first to remove the backing paper and then to develop the relief pattern and then the relief pattern is treated successively with alcohol/water mixture of increasing alcohol concentration and finally with alcohol alone before the liners are set aside to allow the gelatin to harden.

A release finish preferably is applied to the gelatin relief pattern before the two liners, still together, are reinserted into the casting cylinder. A liquid material capable of being formed into a solid polymer is then injected into the casting cylinder while it is rotated rapidly about its axis to produce a cylindrical shell of solid polymer bearing a relief pattern on its outer surface. The shell may be cast by using a single charge or several successive charges of the liquid material. Epoxy resins have been used to make very satisfactory shells for printing.

When the shell has been cast, the two liners and the shell are removed from the casting cylinder as one unit, for example by pushing them out axially with a ram provided with an end piece which is a sliding fit inside the casting cylinder. The peelable liner and the cast shell are then together pushed out axially from the thicker liner, for example by using a ram with an end piece which is a sliding fit inside the thicker liner and opposing its pressure by a ring through which the peelable liner will pass but which retains the thicker liner. The peelable liner may then be peeled off the shell directly or may be left on as a protective sheath until the shell has been converted into the final roller porduct for example by fitting end pieces to it and thereby mounting it on a shaft. The peelable liner may be left in place to afford continued protection until such time as the roller is required for mounting on a printing machine. The peelable liner may be made of a polymeric material which is transparent at least at the thinness of the liner so that the relief image borne by the shell may be visually examined, for example for pattern flaws, without removing the liner. The thicker liner may be used repeatedly for casting a succession of shells.

In the operation of pushing out the shell and the peelable liner together from the thicker liner, for example by the use of a ram, there is a possibility that slip will occur between the shell and the peelable liner rather than between the liners as described. This possibility can be avoided by inserting a narrow strip, say of rubber, and thicker than the peelable liner to be cast, circumferentially around the inner surface of the thicker liner at one end, prior to casting the peelable liner. After the peelable liner has been cast, the strip is removed and the result is that a corresponding strip of the inner surface of the thicker liner is left uncovered by the peelable liner. Thus when a shell is cast within the liners, it will have at one end a lip of the same thickness as the peelable liner. Now, if the shell is pushed at the lipped end against resistance from the thicker liner, the slip must occur between the two liners.

The invention is illustrated by the following Example.

Example

In a centrifugal casting process for making a cylindrical shell for use as a printing roller the centrifugal casting equipment comprised

a metal casting cylinder 10 inches (25.4 cms.) long and 4.75 inches (12.065 cms.) internal diameter. The cylinder had flanges at each end by means of which it could be bolted to end plates. One end plate was supported on a shaft passing through a bearing and the shaft was rotatable by an electric motor. The other end plate was similarly supported except that the shaft was hollow so that the material to be cast could be charged to the casting cylinder therethrough.

In operation, the casting cylinder and the end plates were very lightly greased with a silicone release agent and then the apparatus was assembled. A liquid resin charge consisting of:

"Shell Epikote" 828	500 g.
"Shell Epikure" RTH	250 g.
"Shell Epikure" RTA	25 g.

was introduced into the casting cylinder through the hollow shaft and then the casting cylinder was rotated about its longitudinal axis at 400 r.p.m. The words "Shell", "Epikure" and "Epikote" are all Trade Marks.

After 18 hours the resin had solidified to form a liner which was 0.25 inch (0.635 cm.) thick (the thicker liner previously referred to). The apparatus was then stopped and dismantled, and the solid resin liner was pushed out using a ram. The liner was then freed from traces of grease and subjected to the application of a release finish before being reinserted into the casting cylinder. The procedure for applying the release finish comprised immersing the liner in a solution of 1.5% weight polystyrene and 0.75% weight tricresyl phosphate in n-amyl acetate and then standing the liner on end to allow excess solution to drain off and the solvent to evaporate.

After the liner was replaced in the casting cylinder, a strip of rubber of rectangular cross section, ½ inch (1.3 cms.) by 1/8 inch (0.32 cm.) and about 13½ inches (35 cms.) long was placed circumferentially around the inner surface of the liner at one end. A further liner (the peelable liner referred to previously) was then cast according to the same procedure using the following formulation.

"Shell Epikote" 828	50 g.
"Shell Epikure" RTH	25 g.
"Shell Epikure" RTA	5 g.

The peelable liner was about 0.025 inch (0.635 cm) thick.

The two resin liners were then removed together as a single unit from the casting cylinder and the rubber strip was removed.

A chromated gelatin relief image, consisting of a multiplicity of gelatin nodules about 0.004 inch (0.0102 cm.) square in section and about 0.0017 inch (0.00432 cm.) deep, was formed on the inner surface of the peelable liner by the process referred to previously. The two liners and the relief image, all together as a single unit, were then given a release finish as described above before being reinserted into the casting cylinder. A cylindrical shell of resin was then cast within the casting cylinder according to the procedure already described using two resin charges in succession having the following formulations:

First charge:

"Shell Epikote" 828	300 g.
"Shell Epikure" RTH	150 g.
"Shell Epikure" RTA	15 g.

Second charge:

"Shell Epikote" 828	200 g.
"Shell Epikure" RTH	100 g.
"Shell Epikure" RTA	15 g.
Silica powder 300 mesh	200 g.

When the casting process was complete, the two liners and the shell were pushed out of the casting cylinder as one unit using a ram. The shell and the peelable liner were then pushed out of the thicker liner, again using a ram, with the shell and the peelable liner being pushed from the lipped end of the shell (the formation of this lip is described previously). The thicker liner was then available for use in a further casting process.

The shell covered by the peelable liner was then mounted on a shaft to form a printing roller. Before use as such, the peelable liner was plasticised with warm water and then peeled off the shell taking with it the gelatin relief image. The surface of the roller was generally glass-smooth, was free from scratches and abrasions and bore an indented design for holding printing ink in a gravure printing process.

WHAT WE CLAIM IS:—

1. A process for centrifugally casting a cylindrical shell of a polymeric material comprising injecting into a casting cylinder a first charge of a liquid material capable of being formed into a solid polymer, forming the solid polymer in contact with the inner surface of the casting cylinder whilst the casting cylinder is rotated to form a cylindrical liner, injecting a second charge of a liquid material capable of being formed into a solid polymer into the casting cylinder and forming the solid polymer while the casting is rotated to form a cylindrical shell of polymeric material within the liner, removing the shell and the liner together from the casting cylinder and peeling the liner from the shell.

2. A process as claimed in claim 1 in which a cylindrical shell having a raised or indented design on its outer peripheral surface is made by forming a relief pattern in the form of the inverse of that design on the inner surface

of the liner prior to casting the cylindrical shell.

3. A process as claimed in claim 2 in which the relief pattern is a photographically-produced gelatin pattern.

4. A process as claimed in claim 2 or 3 in which prior to the casting of the peelable liner in the casting cylinder, a thicker liner is cast therein, the two liners being removed together from the casting cylinder, the thicker one as a support for the peelable one, for the purpose of forming the relief pattern on the inner surface of the peelable liner, and then being reinserted into the casting cylinder for the casting of the cylindrical shell.

5. A process as claimed in claim 4 in which the thicker liner, the peelable liner and the cylindrical shell are removed from the casting cylinder together and then the peelable liner and the cylindrical shell are slid out of the thicker liner together before the peelable liner is peeled off the cylindrical shell.

6. A process as claimed in any of claims 1 to 5 in which the cylindrical shell is mounted on a shaft to constitute a printing roller.

7. A process as claimed in claim 6 in which the cylindrical shell is mounted on the shaft prior to the peeling off of the peelable liner.

8. A process as claimed in any preceding claim in which the peelable liner is formed of a polymeric material which is transparent at least at the thickness of the peelable liner.

9. A process as claimed in any preceding claim in which the peelable liner is formed of a polymeric material which is softenable so as to facilitate peeling of the liner from the cylindrical shell.

10. A process as claimed in any preceding claims in which the cylindrical shell and/or the peelabe liner are formed of an epoxy or a polyester resin.

11. A process as claimed in any preceding claim in which a release finish is applied to the inner surface of the casting cylinder and/or the peelable liner.

12. A process as claimed in claim 4 or 5 or any of claims 6 to 11 when appendant to claim 4 in which the thicker liner is formed of an epoxy or a polyester resin.

13. A process as claimed in claim 2 in which a release finish is applied to the relief pattern.

14. A process as claimed in claim 4 in which a release finish is applied to the inner surface of the thicker liner.

15. A process for centrifugally casting a cylindrical shell of a polymeric material substantially as hereinbefore described in the Example.

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